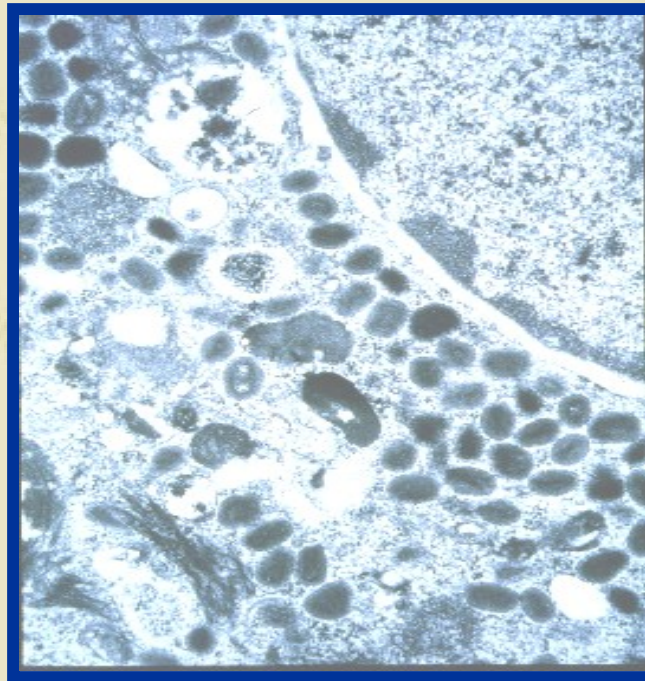




Medical NBC Briefing Series
**Medical NBC Aspects of
SMALLPOX**





Purpose

- *This presentation is part of a series developed by the Medical NBC Staff at The Office of The Surgeon General for the Army.*
- *The information presented addresses medical issues, both operational and clinical, of various NBC agents.*
- *These presentations were developed for the medical NBC officer to use in briefing either medical or maneuver commanders.*
- *Information in the presentations includes physical data of the agent, signs and symptoms, means of dispersion, treatment for the agent, medical resources required, issues about investigation and epidemiology, and*
- *Notes*



Office of the Surgeon General
for the Army



Outline

- **Background**
- **Battlefield response**
- **Medical response**
- **Command and control**
- **References**





Background

- General Background
- Disease Background
- Smallpox Disease Course Summary
- Signs and symptoms
- Treatment
- Transmission
- Weaponization
- Current situation



variola particles



General Background

- **Smallpox was a major cause of morbidity and mortality in developing world until recent times**
- **Outbreaks throughout history**
- **Example: 18th century England**
 - 1/10 of all deaths
 - 1/3 of deaths of young children
- **Fatality rate 20 to 40% during the 1970s**

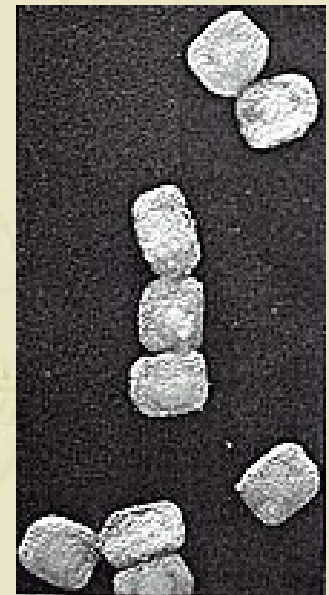


Color woodcut from nineteenth-century Japan showing the hero Yoritomo victorious over demon smallpox.



Disease Background

- Caused by the *Orthopoxvirus* virus
- Two basic forms of the disease:
 - *Variola major* - Higher mortality rate of 3% in vaccinated individuals and 30% in unvaccinated individuals.
 - *Variola minor*- Lower mortality rate of 1% in unvaccinated individuals.
 - This presentation will concentrate on *Variola major*.



variole particles



Smallpox Disease Course Summary

Day 1 Exposure	Day 2	Day 3 Exposed individuals ambulatory with no symptoms	Day 4	Day 5	Day 6	Day 7
← Incubation in lungs →						
Day 8 Exposed individuals ambulatory with no symptoms	Day 9	Day 10	Day 11	Day 12 Patients ambulatory or littered based on severity of symptoms	Day 13 Acute malaise, fever, rigors, headaches	Day 14
← Incubation in lungs →						
Day 15	Day 16	Day 17	Day 18 Patients littered	Day 19	Day 20	Day 21
← Rash appears on face, hands and forearms →						
← Contagious →						
Day 22 30% fatality in untreated patients due to toxemia	Day 23	Day 24	Day 25 Patients littered	Day 26	Day 27	Day 28
← Rash spreads to trunk and progresses to scabs →						
← Contagious →						
Day 29 Patients littered and ambulatory	Day 30	Day 31	Day 32	Day 33	Day 34	Day 35
← Scabs separate and patients become non-contagious →						



Signs and Symptoms - Exposure

- **Infectious by exposure to aerosolized virus**
- **Infectious by person-to-person contact**
 - droplet nuclei
 - direct contact
 - contaminated clothing or bed linens





Signs and Symptoms - Incubation

- **Incubation period averages 12 days**
 - Period may be shorter for biological warfare aerosolized exposure
- **Acute clinical manifestations 13 to 14 days after exposure**
 - Malaise, fever, rigors, vomiting, headache, backache
 - 15% of patients develop delirium
 - 1% of light-skinned patients exhibit a transient rash
 - Patients are littered and require supportive care
 - Patients most infectious the first 7 to 10 days of the rash
 - Close contacts are most susceptible to infection



Signs and Symptoms

- **14 to 15 days after exposure: skin lesions (exanthem) begin to appear**
 - Begins on face, hands, and forearms
 - Spreads to lower extremities
 - Spread to trunk over next week
 - Lesions to scabs (patients infectious until scabs separate)
- **Mortality rate of 3% in vaccinated individuals and 30% in unvaccinated.**



Smallpox - Progression

Figure 2. Typical Case of Smallpox Infection in a Child



Figure shows the appearance of the rash at days 3, 5, and 7 of evolution. Note that lesions are more dense on the face and extremities than on the trunk; that they appear on the palms of the hand; and that they are similar in appearance to each other. If this were a case of chickenpox, one would expect to see, in any area, macules, papules, pustules, and lesions with scabs. Reproduced with permission from the World Health Organization.²



Smallpox - Exanthem





Smallpox - Exanthem





Other Clinical Variants

- **Hemorrhagic smallpox (<3% of patients)**
 - severe malaise, high fever, headache, backache, abdominal pain
 - red rash with frank bleeding under the skin
 - death usually occurs by the 5th or 6th day of rash onset
- **Flat-type smallpox (2-5% of patients)**
 - malaise, high fever, aches
 - slow evolution of flat, soft focal skin lesions
 - 66% mortality in vaccinated patients
 - 95% mortality in unvaccinated patients
- **Monkeypox in Africa**



Treatment

- **Confirmed variola**
 - International emergency-*immediate* report to command and public health authorities
- **Quarantine**
 - Including respiratory isolation for 17 days for cases and all close contacts
- **Supportive therapy**
 - Antibiotics for secondary bacterial infections
 - No antiviral is available



Postexposure Infection Control

- Infection control information and vaccines are available from the CDC drug service and U.S. Army
- Live Vaccinia virus vaccination
- Vaccinia-immune globulin (VIG) in conjunction with live vaccinia virus inoculation





Transmission and Infectivity

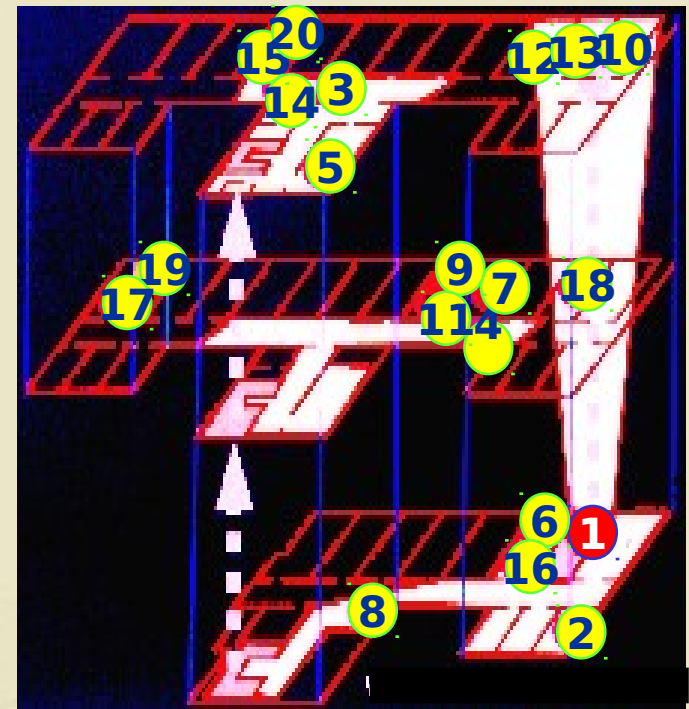
- **Transmission occurs predominantly through face-to-face contact**
 - in “natural” transmission, 1 case yields 1-3 new cases
 - “hyperspreaders” are rare but can yield 16-23 cases
 - 36-88% of unvaccinated individuals with close exposure develop disease



Example of Infectivity

MESCHEDE HOSPITAL

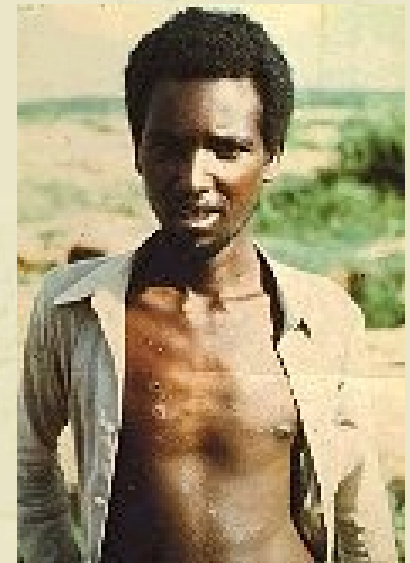
- Electrician admitted 10 days after returning from Karachi, Pakistan
- Developed rash on 3rd hospital day
- Smallpox confirmed 5th hospital day
- The electrician had densely confluent rash, severe bronchitis, and cough
- All patients and staff vaccinated or given VIG
- 19 others contracted the disease





Present Situation

- **Declared eradicated in 1980 by World Health Organization (WHO)**
- **Vaccinations of civilians ceased in the early 1980's and for military in 1989**
- **1983 - virus consolidated to two sites**
 - CDC, Atlanta, GA
 - State Research Center of Virology and Biotechnology, Koltsovo, Russia



Somalia, 1977 - Ali Maalim
Last recorded case of naturally caused smallpox

Present Situation (Vaccine)

- **Discontinuation of routine vaccination during the 70s**
- **Duration of immunity offered by the vaccine unknown**
 - Studies have shown that the antibodies to decline substantially 5 to 10 after vaccination
- **20 million doses held by World Health Organization**
- **Remaining licensed vaccine in U.S.**
 - 12 million doses held by CDC drug service
 - Potential

Figure 4. Typical Appearance of an Evolving Primary Vaccination Take

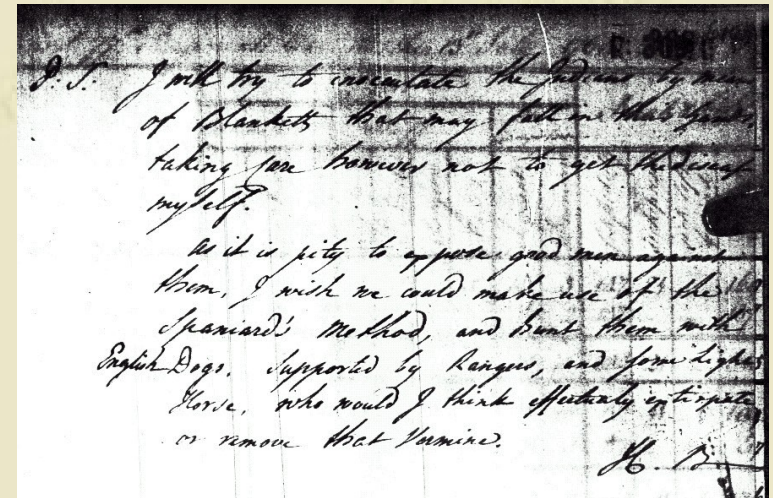


Reproduced with permission from the Centers for Disease Control and Prevention.³



Weaponization

- **Dispersion by contact**
 - In 1763, Sir Jeffrey Amherst gives blankets used by smallpox patients to Native Americans
 - During World War II, infamous Japanese Unit 731 experiments with weaponization



Letter from Colonel Henry Bouquet to General Amherst dated 13 July 1763 suggesting in a postscript the distribution of blankets to "inoculate the Indians"



Weaponization

Viability of Vaccinia Virus in Aerosols at Various Intervals After Spraying ⁹					
Temperature, °C	Relative Humidity, %	Viable Vaccinia, %*			
		1 h	4 h	6 h	23 h
10.5-11.5	20	82	79	81	66
	50	83	92	77	59
	82-84	79	59	60	27
21.0-23.0	18-19	66	46	45	15
	48-51	86	57	50	12
	82-84	66	24	18	Trace
31.5-33.5	17-19	61	51	33	13
	50	51	26	15	Trace
	80-83	36	5.9	1.2	Trace

*Initial titer of $10^{7.7}$ plaque-forming units per milliliter of McIlvaine buffer, containing 1% dialyzed horse serum.

- **Wide area dispersion by aerosol (2-10 micron particle size)**
- **Soviets weaponized metric tons of smallpox and produced extremely lethal variants.**



Battlefield Response to Smallpox

- **Protect**
- **Vaccinate**
- **Detect**





Protect



- **Individual Protection**

- Mask only is sufficient for respiratory protection against smallpox.
- Standard uniform clothing affords a reasonable protection against dermal exposure to biological agents.
- Casualties unable to wear MOPP should be handled in casualty wraps.

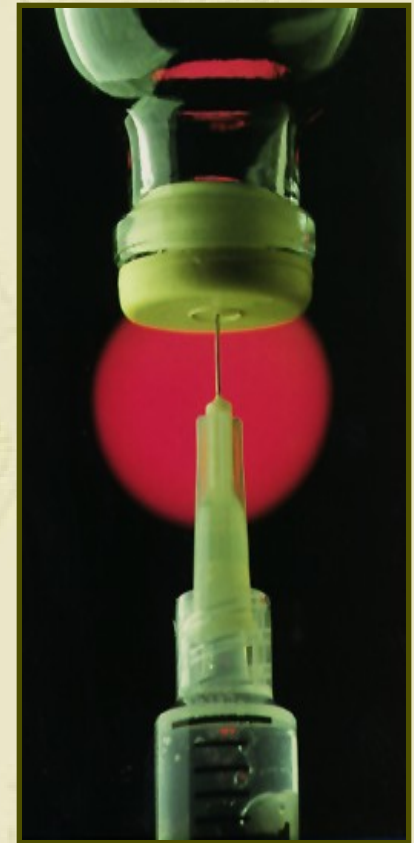
- **Collective Protection**

- Hardened or unhardened shelter equipped with an air filtration unit providing overpressure.
- Use strict barrier nursing techniques if any contagious individuals are brought inside the collective protection units.



Vaccinate

- **Suggested for all who have come into contact with suspected smallpox patient**
 - Vaccination even seven days after the exposure reduces the chances of smallpox
 - Command decision to vaccinate all in theater or only those who have been exposed
 - Vaccination of all in theater will require more supplies, but may be less manpower intensive
 - Identification of all who have exposed may be very manpower intensive





Vaccinate

- Suggested for area with high threat of use
- BioReliance to begin manufacturing 300,000 doses initially by the end of 2000
- Complications of vaccination

Table 1. Complications of Smallpox Vaccination in the United States for 1968—Centers for Disease Control and Prevention National Survey⁴⁵

Vaccination Status, Age, y	Estimated No. of Vaccinations	No. of Cases						Total
		Postvaccinial Encephalitis*	Progressive Vaccinia*	Eczema Vaccinatum*	Generalized Vaccinia	Accidental Infection	Other	
Primary vaccination†	5 594 000	16 (4)	5 (2)	58	131	142	66	418
Revaccination	8 574 000	0	6 (2)	8	10	7	9	40
Contacts	...‡	0	0	60 (1)	2	44	8	114
Total	14 168 000	16 (4)	11 (4)	126 (1)	143	193	83	572

*Data in parentheses indicate number of deaths attributable to vaccination.

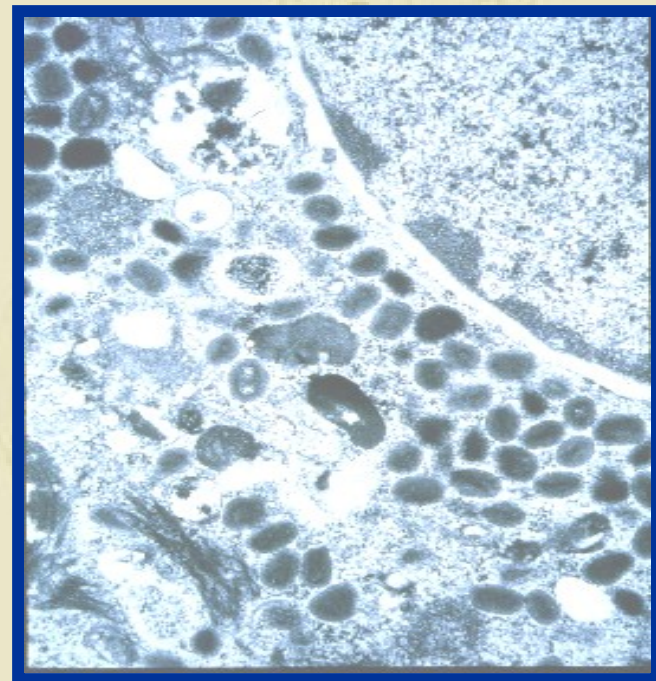
†Data include 31 patients with unknown vaccination status.

‡Ellipses indicate contacts were not vaccinated.



Detect

- **Possible methods of detection:**
 - Detection of agent in the environment
 - Clinical
 - Medical surveillance
- **Coordination enhances detection capability.**
- **While the presence of smallpox is presumptive evidence of a BW use, it is not conclusive.**





Detection of Agent in the Environment



- **Biological Smart Tickets**
- **Enzyme Linked Immunosorbant Assay (ELISA) (Fielded with the 520th TAML)**
- **Polymerase Chain Reaction (PCR) (Fielded with the 520th TAML)**





Detection of Agent in the Environment

- **M31E1 Biological Integrated Detection System (BIDS)**
- **Interim Biological**





Detection - Clinical

- **Present day clinicians lack experience in diagnosis of smallpox and must be able to identify smallpox from other similar disease processes:**
 - Varicella (Chicken Pox)
 - Enteroviruses (polio, Coxsackievirus)
 - Dermatitis herpetiformis (herpes)
 - Secondary syphilis
 - Contact dermatitis (common rashes)
- **As soon as smallpox is suspected, clinicians should inform the chain of command.**
- **Clinicians will forward samples to medical laboratory for confirmation of diagnosis.**



Detection - Laboratory

- **Division medical assets lack lab equipment to conduct test to determine smallpox**
- **Specimen must be sent to theater level or CONUS lab**
 - pustular fluid and scabs in closed tube
 - unit SOP's for collection
- **Lab specimens should be submitted to the correct diagnostic laboratory**
 - responsibility of the Lab Officer
 - ensure the chain of command is aware of the situation
- **Contact lab prior to collection or preparation in order to assure proper methods are utilized**
- **Cell culture and electron microscopy**



Detection - Laboratory

- **Points of contact for biological sampling and shipping**
 - Corps Chemical Officer
 - Technical Escort Unit
 - AFMIC
 - 520th TAML
 - USAMRIID
 - WRAIR
 - CDC



Detection - Medical Surveillance



MARYLAND ARMY NATIONAL GUARD
DISCOM 29th Infantry Division (Light)
DIVISION MEDICAL OPERATION CENTER (DMOC)



Patient Summary Report 29th INF (L) DIV

From: Division Medical Operations Center (DMOC)
To: Division Surgeon

Date Time Group: From: 121200RJUN99
To: 202400RJUN99

PATIENTS

Nation	WIA	NBI	Disease	Neuropsychiatric Stress-Related	Total
US	0	97	55	0	152
Allied	0	0	0	0	0
EPW	0	0	0	0	0

DISPOSITION

Return to duty	148
Holding in Division's MTFs	0
Evacuated and returned	3
Evacuated by air	0
Evacuated by ground	1
Expired en route	0
Expired in MTF	0

- **Clues in the daily medical disposition reports**
 - Unexpected high numbers of fevers, malaise, headaches, body aches, severe abdominal pain
 - Rashes originating on face and extremities



Medical Response to Smallpox

- Evacuation or Quarantine
- Infection Control
- Resource Requirements





Medical Response

- All infected and exposed individuals must be quarantined immediately.
- Immediate vaccination of all exposed.
- Since smallpox takes a number of days to fully develop, the standard procedure would be to evacuate all patients as ROUTINE out of the theater (IF patients are not quarantined in theater).
- Alternatively, the Commander may consider patients quarantined in theater to prevent future spread.



Evacuation or Quarantine



Figure 8-6. Arms carry.

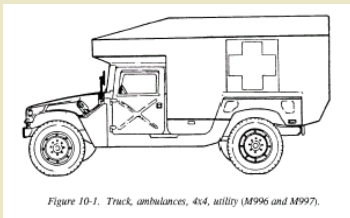


Figure 10-1. Truck, ambulances, 4x4, utility (M996 and M997).

- **Evacuation**
 - Smallpox patients not like to RTD in the normal theater evacuation policy of 15 days
 - Strict interpretation of the doctrine calls for evacuation
- **Quarantine**
 - Very contagious
 - Limit spread of the virus
 - Keep patients in the area of the outbreak
- **Guidance**
 - Before evacuating any patients suspected of smallpox, seek guidance from CINC
 - Decision on movement will probably become a NCA issue



Evacuation (if chosen)



- **Evacuation should follow normal evacuation and triage procedures.**
 - Ambulatory if early in the disease process (first two weeks)
 - Littered as disease progresses (weeks 3 and 4)
- **Strict respiratory isolation during transport by both ground and air.**
 - Communication with receiving facilities is crucial for reduction of disease spread.



Quarantine (if chosen)

- **Command may consider quarantine of the entire theater to prevent future spread.**
- **Medical units may be required to treat patients in theater for extended times.**
 - More resources required than normal
 - Alternate plans for supply and personnel
- **Preventive medicine and disease prevention requirements will increase.**



Infection Control

- **Immediate vaccination (or boosting) of ALL potential contacts including health care workers**
- **Respiratory isolation precautions**
- **Universal precautions including masks and gowns**
- **Patient remains**
 - Cremation of expired patients is recommended in JAMA
 - Political, cultural, and religious factors may prevent this





Infection Control

- **Decontamination**

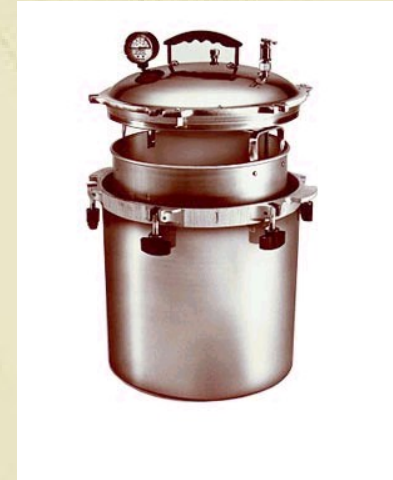
- Aerosolized virus may persist for 24 hours in the environment
- Widespread environmental decontamination probably not required by the time patients become ill (10 days after exposure)

- **Bedding and clothing - Sterilization**

- autoclaved or washed in very hot water with bleach

- **Surfaces**

- standard hospital disinfectants such as hypochlorite or quarternary ammonia



Autoclave



Resource Requirements

- Quarantine and isolation facilities
- Vaccinia vaccines
 - smallpox vaccine
 - immunoglobulins
- Supportive therapies
 - antibiotics
- Assuming normal evacuation and diagnosis, smallpox patients will probably not require ICU beds while in theater
- Decontamination facilities
 - autoclaves
 - washing facilities





Resource Requirements for Theater Quarantine

- **Smallpox patients will be in theater longer and progress to advance stages of the disease**
 - Additional beds, including significant numbers of ICU beds
 - Additional medical and support staff
 - Additional medical supplies
 - Additional non-medical supplies
 - Vaccination requirements
 - Decontamination requirements (autoclaves, supplies)
 - Mortuary



Command and Control

- **Intelligence**
 - Medical surveillance and intelligence reports key to keep the Command alert to the situation
- **Maneuver**
 - Limit movement of affected units to prevent disease spread
- **Logistics**
 - Isolation of affected units and maybe theater will strain the supply chains
- **Manpower**
 - Significant reduction in both the numbers of soldiers entering and leaving the theater



Command Response to Psychological Impact

- **Individuals** - may vary from person to person
- **Psychological Operations**
 - Rumors, panic, misinformation
 - Soldiers may isolate themselves in fear of disease spread
 - Physical appearance of the rash may adversely affect other soldiers
- **Countermeasures**
 - LEADERSHIP is responsible for countering psychological impacts through education and training of the soldiers
 - Implementation of defensive measures such as crisis stress management teams



Summary



- Smallpox is very contagious
 - Population very susceptible
 - Smallpox has been weaponized
 - Need to coordinate detection and laboratory units with medical units
-
- Command decisions that will be required upon detection of smallpox:
 - Vaccination: all or only known exposed
 - Evacuation or quarantine



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**Battelle Memorial Institute
created this presentation for
the U.S. Army Office of the
Surgeon General under the
Chemical Biological
Information Analysis Center
Task 009, Delivery Number
0018.**